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THE CLIMATE OF THE PHILIPPINES.*

BY

WALTER S. TOWER.

The Philippine Islands lie about along the line connecting Borneo and Formosa, between Lat. $4^{\circ} 45'$ and $20^{\circ} 3' N.$ and Long. $116^{\circ} 4'$ and $126^{\circ} 34' E.$ The extension from north to south corresponds to the distance between Milwaukee and New Orleans. The number of the islands is not definitely known, but it has been estimated as high as 1,400. Their area is calculated as nearly equal to that of New England and New York State combined.

Supan, in his division of the world into climatic provinces, places the Philippines in the "Polynesian tropical" province, which is described as a "tropical climate ameliorated by the ocean, so that mild summer weather prevails throughout the year. On the loftier islands rain is abundant and has a tropical periodicity." In a less detailed classification the Philippines are included in the so-called "hot belt"—a temperature zone bounded by the mean annual isotherms of $68^{\circ} F.$ The mean annual heat equator crosses the southern limit of Mindanao, one of the most southern islands. Most of the islands south of Luzon are in the area bounded by the mean annual isotherm of $80^{\circ} F.$; Luzon and a few small islands north of it are limited by the isotherms of $75^{\circ} F.$ The whole archipelago is within the region of less than 5° of mean annual range of temperature.

The climate may be summarized as follows: High temperature throughout the year; small annual and relatively small diurnal ranges; humid, with excessive rainfalls at times; at certain seasons violent tropical storms, locally called *baguios*.

As the basis of our study of the Philippine climate it is necessary to take the observations made at Manila from 1885 to 1898, since data for other places in the archipelago, except in a few instances, are meagre, or else are entirely lacking.†

* This article formed part of a thesis on *Climate and Man in the Philippines*, written for the course in Climatological Research (Geology 26) given by Professor R. DeC. Ward, in Harvard University.

† Report of Philippine Commission, 1900, Vol. IV., pp. 129-357.

MEAN MONTHLY TEMPERATURES AT MANILA.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
79°.5	80°.2	83°	85°.7	86°.1	84°.8	83°.5	83°.5	83°	83°	81°.7	79°.8	82°.9

Range: 5°.6.

If we compare these figures with those for Aparri, Lat. 18° 25' N., and La Carlota, Lat. 10° 30' N., respectively the most northerly and southerly points for which data are at hand, we find that the former has a mean annual temperature of 81°.7; a January mean of 76°.8; a June mean of 85°.9; and a mean annual range of 9°.1. The latter station has a mean annual of 82°.3; a January mean of 80°.6; an April-May mean of 84°.4; and a mean annual range of 3°.8. This comparison brings out the characteristic seasonal uniformity of tropical climate, combined with a sustained high temperature over the whole archipelago; the mean annual temperatures of Aparri and La Carlota differing by but 0°.6, although the two stations are separated by 8° of latitude.

The mean monthly absolute maxima and minima at Manila are given in the following table:

MEAN MONTHLY ABSOLUTE MAXIMA AND MINIMA.

	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
Max....	92°.99	95°.0	97°.1	99°.4	100°.4	96°.1	95°.38	94°.8	94°.8	95°	94°.1	92°.8
Min....	65°.8	66°.4	68°.48	71°.9	75°.1	74°.9	74°.4	74°.4	74°.7	73°.3	70°.7	66°.9

The absolute maximum recorded was 103°.8, in May, 1889; and the absolute minimum 61°.8, in December, 1892. As regards the variation of temperature during the day, the minimum, as would be expected, comes just before sunrise, about 6 A.M.; and the maximum about 2 P.M. These hours vary slightly, from month to month, with the cloudiness. The mean diurnal range of temperature is as follows:

MEAN DIURNAL RANGE OF TEMPERATURE AT MANILA.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
14°.4	16°.1	16°.3	16.7	13°.3	11°.4	9°.5	9°.1	8°.7	10°.6	10°.8	11°.7

The maximum diurnal range comes in the hottest month. The minimum range does not occur in the coldest month, but in September, which has nearly the maximum amount of cloudiness. Thus, the diurnal range is seen to be largely dependent upon the cloudiness; the clear months have large diurnal ranges, and the cloudy months small ranges.

From the fact that our climatic district is surrounded by the ocean on all sides, we should expect to find a high relative humidity. This expectation is borne out by the mean annual relative humidity of 79.4%; the maximum coming in September, the minimum in April. On the basis of observations made at Manila during the years 1856-1898, inclusive, the annual rainfall is 75.5 inches. This amount is distributed through the year as follows:

MEAN MONTHLY RAINFALL AT MANILA (INCHES).

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
1.2	0.4	0.7	1.1	4.2	9.6	14.6	13.9	14.9	7.5	5.1	2.1	75.5

Thus, there is a minimum of rain in the months from January to April, with the absolute minimum in February; and there is a maximum of rain in July, August, and September, with the absolute maximum in the latter month. These months of maximum and minimum rainfalls we should expect to find corresponding with the months having the maximum and minimum number of rainy days. (By a rainy day is meant a day on which a *trace* of rain is observed.) This correspondence is shown in the following table:

MEAN MONTHLY NUMBER OF RAINY DAYS AT MANILA.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
5.1	2.8	3	3.7	9.1	15.6	20.6	20.3	20.2	16	11.17	7.9	135.9

Like all tropical regions, these islands are at times subject to excessive rainfalls. For example, the absolute maximum of rainfall during the period of years mentioned above was 117.3 inches, in 1867. In the same year the absolute maximum of monthly rainfall was recorded in September, 57.86 inches, 13.2 inches of which fell in a single day. The heaviest rainfall ever recorded, in a short time, was in August, 1899, when, under the influence of what is described as an "electric tempest," 1.96 inches of rain fell in 7 minutes.

The distribution of rainfall suggests a classification of the seasons in the Philippines, viz.: a wet season from June to October, and a dry season from November to May. This does not imply that the dry season is absolutely without rain, nor that there is a continual downpour in the rainy season. That this is far from being the case is brought out by a comparison of rainy days and the percentages of total rainfall in the two seasons.

NUMBER OF RAINY DAYS AND PER CENT. OF TOTAL RAINFALL IN THE WET AND DRY SEASONS.

	RAIN.		DAYS OF RAIN.	
	AMOUNT (INCHES).	PER CENT.	NUMBER.	PER CENT.
Dry Season.....	14.95	20	43	31
Wet "	60.5	80	93	69

No month is absolutely without rain except in years of unusual dryness. Hence, although the seven months of the "dry" season have but $\frac{1}{5}$ of the total rainfall, it is not absolutely a dry season. On the other hand, the rainy season is so called because the total rainfall is always greater than the amount precipitated in the other seven months. Some writers have used the terms wet and dry season as if they were applicable to the whole archipelago, and as embracing the same months at all places. Others contend that the terms can be applied to certain portions of the group only. In the islands of Panay, Cebú, and on the west coast of Mindanao, the dry and rainy seasons occur in the same months. The difficulty in applying this division of seasons to the islands of Luzon and Mindanao as a whole lies in their size, which makes it possible for topographic features so to control the precipitation that the wet and dry seasons may vary considerably as to time of occurrence within a relatively small area. This fact has often been noted by travellers, many of whom say that by planning one's route of travel carefully it is possible to avoid the rainy season altogether.

The mean monthly cloudiness for Manila is shown in the following table:

MEAN MONTHLY CLOUDINESS AT MANILA (0-10).

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
4.6	3.8	3.8	3.5	5.1	6.8	7.5	7.5	7.4	6.1	5.8	5.6	5.6

As would be expected, the months of maximum and minimum cloudiness are also the months of maximum and minimum rainfall. The months of maximum temperature, too, may be seen to correspond roughly with those of least cloudiness. The minimum temperature does not show this relation to maximum cloudiness, the former coming in January and the latter in September. The explanation of this fact probably lies in the position of the sun north of the equator at the time of greatest cloudiness.

During the greater part of the year the islands are under the influence of the northeast trade-winds; but the southward extent of the islands brings them under the influence of the diverted south-

east trades—the so-called southwest monsoon. The northeast wind blows during seven months of the year; the southwest wind being felt during the four summer months—June, July, August, and September; May and November have variable winds. At Manila the southwest wind prevails during six months of the year, from May to October; whereas the northeast wind prevails only from February to April. This peculiarity is probably due to some local condition arising from the situation of Manila at the head of a broad-mouthed bay, opening toward the southwest. The farther north one goes, the stronger becomes this trade-wind influence. At Aparri, in the northern part of Luzon, the most prevalent winds, even in the months from July to September, are from the northeast. At Iloilo, in Panay, the most southerly point for which data are obtainable, the prevailing winds during seven months of the year have the northerly components. In the other five months winds from the south and southwest prevail. This station, being $7^{\circ} 8'$ south of Aparri, feels the well-developed southwest monsoon; but even there the southwest wind does not prevail through as many months as at Manila.

Although it has been seen that certain months have a northeast wind, and others a southwest wind, these are not the only wind directions that are noted; nor is there a sudden change from one to the other. In passing from one season to another all the intermediate stages of wind direction are observed. The wind gradually shifts around the compass, in what may be called the transitional season, until it blows prevailingly from the opposite direction. With an east and west extension of the islands, prevailing winds would seem to offer a good basis for a classification of the seasons, but the fact that the southern islands have the southwest monsoon during a longer period makes it impossible to fix upon any seasons which shall comprise the same months in all parts of the islands.

The *baguios*, or typhoons, and the so-called “tornadoes” of the Philippines also need mention. *Baguios* are the oriental equivalent of our West Indian hurricane. They originate in the Pacific Ocean or in the China Sea, in the region bounded by 5° and 20° N. Lat. and 125° and 150° E. Long. These revolving storms are often of great violence, and cause much damage along the low-lying coasts. For example, the typhoon of October 30, 1875, destroyed over 3,000 houses and resulted in the loss of 250 lives. On this account a great deal of careful work has been done at the Manila Observatory, in order to bring the prediction of the *baguios* to the greatest possible degree of accuracy. At first predictions were based on

barometric indications only. These observations were sufficient as far as an indication of the existence of a typhoon was concerned, but gave no idea of the direction in which the vortex of the storm lay. More recently, the observations of clouds at Manila have been seen to furnish a reliable means of determining both the existence of a baguio and the bearing of the centre. In order to facilitate the determination of the storm's position, and of its probable distance, Father José Algué, Director of the Observatory, has invented his so-called *baro-cyclonometer*. This is an ingenious association of an aneroid barometer and a cyclonometer—the latter being a representation of the surface winds in a typhoon.*

Between 1880 and 1898, February was the only month in which no baguios occurred. During the other months they have been distributed as follows:

BAGUIOS AT MANILA FROM 1880 TO 1898.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	YEAR.
6	0	3	9	24	35	66	63	79	54	40	18	397

The total, 397, represents the number of baguios which passed near enough to the Observatory at Manila to make their influence felt there.

"Tornadoes" in the Philippines are not the same phenomena as our well-known western storms of the same name, but are like our ordinary thunderstorms. That these are very frequent is seen from a record of those occurring at Manila from 1888 to 1897:

"TORNADOES" AT MANILA, 1888-1897.

JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL.
29	16	89	321	1,003	907	697	621	623	529	168	47	5,050

This gives a monthly average of 1.6 for February, 100.3 for May, and a yearly average of 505 during the ten-year period. Like our thunderstorms, the "tornadoes" are less frequent between 7 and 11 A. M. Worcester speaks of thunderstorms as a regular occurrence shortly after 10 A. M. in Tawi Tawi, one of the most southerly islands†. The majority of more violent storms come in the afternoon; the intensity decreasing towards night.

The early Spanish settlers described the Philippine climate as "Seis meses de lodo, seis meses de polvo, seis meses de todo" (six months of mud, six months of dust, six months of everything).

* A description of this instrument, with illustrations, may be found in Report of Philippine Commission, 1900, Vol. IV., pp. 326-338.

† Worcester: "Philippine Islands and their People," p. 209.

A recent writer, recognizing a different phase of the climate, divides the year into "the small-pox season and the cholera season," corresponding roughly to the familiar classification into wet and dry seasons.* Others have described the climate as "lovely," or "deadly," or "not unhealthy for the tropics." It is hot throughout the year in the Philippines, and oppressively hot during a part of the year. The humidity is prevailingly high, and this, with the constant high temperatures, makes the heat hard to bear, and has an enervating effect on a Northern constitution. Some writers have claimed that people accustomed to the high summer temperature of our southwest will have no difficulty in enduring the heat of the Philippines. The dry air of Arizona and New Mexico, however, offers no parallel to the damp "hot-house" air of Manila. In these States the dry bulb thermometer may truly read 20°-25° higher, but the relative humidity is much less, and the *sensible* temperature, which the body feels, is much lower than in the Philippines. In some months, notably December, January, and February, the Philippine climate is at its best; for during these months the temperature and the humidity are both lower, the rainfall is light, and baguios and thunderstorms are least frequent. In these months, too, the nights are cooler. During the remainder of the year, however, the conditions of heat, humidity, heavy rains, and the greater prevalence of contagious diseases are undoubtedly very trying for Northerners.

Regarding the general situation in which a Northerner finds himself in the climate of the Philippines, Worcester says†:

The facts are as follows: if one is permanently situated in a good locality, where he can secure suitable food and good drinking water; if he is scrupulously careful as to his diet, avoids excesses of all kinds, keeps out of the sun in the middle of the day, and refrains from severe and long-continued physical exertion, he is likely to remain well, always supposing that he is fortunate enough to escape malaria infection.

The question has also been answered by Maj. Chas. F. Mason, Surgeon 26th U. S. V. I., who says‡:

If that term [acclimatization] is intended to convey the idea that the constitutions of white men gradually adjust themselves to tropical conditions and thereby become better able to withstand disease, then I do not think there is any such thing as acclimatization. Men do gradually learn to take better care of themselves, and to that extent are less liable to disease, but in my opinion the great majority of white men in the tropics suffer a gradual deterioration of health, and year by year become less and less fit for active service.

* Hamm, M.A.: "Manila and the Philippines," p. 11.

† Loc. cit., p. 65.

‡ Rept. Surg.-Gen. U. S. A., 1901, 130.

Another officer says*

the most energetic and stalwart American after a year of service in the Philippines loses energy, strength, and ambition. He performs what work his duty demands in a more or less half-hearted way, and with a draft on his vital energy that he can actually feel at the time.

The London *Lancet*,† the leading medical journal in the world, in an editorial in which the experiences of the English in the tropics are largely taken as the basis of argument, maintains

that residence in hot climates under the circumstances of ordinary life has an adverse effect upon Europeans cannot, we think, be doubted. Some constitutions seem to be altogether unfitted for these climates, and such individuals lose their health and physical energy from the moment of their arrival. A still larger number do so sooner or later under a more protracted residence, even if they escape being attacked by one or the other of the endemic or epidemic diseases incidental to such climates. Residence in tropical and sub-tropical countries usually produces a very appreciable effect, not only on the complexion but on the constitution, and notably so during childhood and youth.

Prof. W. Z. Ripley, in summarizing the question of acclimatization as discussed by English, French, and German authorities,‡ says that the almost universal opinion seems to be that true colonization of the tropics by the white race is impossible. But

it must not be understood that by this is meant that the white man cannot live in the tropics. Hygienic precautions and great care often render a prolonged sojourn in these regions perfectly harmless. A colony can, however, never approximate even to the civilization of Europe until it can abolish or assimilate the native servile population; and yet one of the many things which are expressly forbidden to all colonists in the tropics is agricultural labor. . . . Let it be understood, then, that a colonial policy in the tropics means a permanent servile native population, which is manifestly inconsistent with a political independence, or with any approach to republican institutions.

The result of these conditions will probably be that few Americans will settle in the Philippines. A few will be obliged to go there as officials and soldiers; and they, by exercising great care, may live there with a fair chance of good health. The colonizing race must always be in small numbers, while the natives constitute the mass of the population. The separation of these two classes must surely give rise to serious governmental problems, while the native indolence of the Filipino will cause grave problems of labour.

* Loc. cit., p. 130.

† *Lancet*, June 3, 1899, p. 501.

‡ *Pop. Sci. Mo.*, XLVIII, 1896, 788-790.